ON FOOD,

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HENRI ERNI, M. D.

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Physiology teaches that the first conditions upon which animal life is dependent, are nutritious matter and air; and furthermore, that the animal body during the whole period of its existence, continually loses (by respiration and secretion) material which must be replaced; otherwise it meets speedily with destruction. In other words, all our organs, tissues, etc., are from time to time destroyed by chemical agencies and are reproduced from blood, or indirectly, from food, (change of matter.) There remains a curious and unexplained fact, how even the substance of our brain may be repeatedly renewed without our loosing the capability of recollection.

The animal organism is absolutely incapable of producing elementary matter, such as carbon, nitrogen, iron, lime, etc. Our body is, therefore, slavishly bound by the reception of material placed around us, which is supplied from the animal, vegetable and mineral kingdoms.

The process, by means of which those materials are converted within our system, into the most suitable form, and the appropriation of them for the development of our body, we call nutrition.

In our childhood, during the period of growth, the amount of nutriment received exceeds the expenditure of

material; at a later period in life the process of nutrition and the more purely chemical process of respiration and secretion—striving to break down our body—hold each other in equilibrium,—*i. e.*, the body does not change its weight. In old age the chemical process predominates, more matter is rejected, than is taken up; the blood is found to contain less solid matter, corpuscles, albumen, etc., the organism undergoes a kind of slow starvation, its functions cease aud inevitably death ensues.[1.]

From what we have said above it follows, that our blood, flesh, membranes, skin, hair, etc., all containing essentially, nitrogen, cannot be built up of food destitute of this element, (the atmospheric nitrogen taking no active part in the animal economy.)

Those nitrogenous compounds (such as albumen, caseine, fibrine) found in all proper food, have been called by Liebig *plastic* (sanguigenous) *elements* of nutrition, whilst the *non-nitrogenous* (such as starch, sugar, fat—only passing through the body) are termed *elements of respiration.* This class of compounds uniting with the oxygen introduced through the lungs in respiration undergo a kind of slow combustion and are discharged as carbonic acid and water (the ordinary products of combustion) by the lungs, skin and kidneys. This process is the source of animal heat.

Efficient nutriments must then possess a twofold character—they must contain blood-forming and respiratory matter.

The young animal lives entirely on milk; this liquid must be perfectly fitted to sustain life, and is therefore considered the standard of food. The same is found to be the case with the egg, which contains everything necessary for the support of the growing fowl, some air being absorbed through the shell.

Speaking of animals generally, we find that the organization of each kind corresponds to its prescribed diet and mode of living; thus some are designed to live on vegetables, others on animal food only. Choosing here, as an example, only the higher mammalia, those approaching man, the structure of their teeth, etc., is in accordance with the nature of aliments upon which they are destined to live, and thus we classify them into graminivorous, carnivorous and frugivorous animals (monkeys;) man aloneis truly said to be the only omnivorous creature.

Let us next endeavor to answer the question, upon what does man live?

The Gaucho, who in the great pampas of Buenos Ayres lives by catching (with his lasso and bolas) wild cattle, consumes daily from 10 to 12 ℔s. of meat and considers it a great treat when he accidently comes in possession of some vegetable food; whilst, on the contrary, the Irishman has to be contented with a meal of potatoes, and feels lucky when at intervals he gets hold of a fish, or a piece of meat. Here we see the Greenlander in his cabin almost burried in ice and snow, feeding on seal and whale's oil. There we find the indolent negro sucking his sugar-cane and feeding on plantains; or the wayfaring Spaniard eating his onion together with an humble crust of bread. In the meantime the industrious Chinese brings his well fattened rats and dogs to market; whilst the African traveler crossing the sandy deserts, carries along his bag of dates, often his only food for weeks. Again the shepherds of the Alps are obliged to live for months on milk and cheese; whilst the Hindoo loads his stomach with so vast quantities of rice as to frighten a European. Thus a traveler, passing from country to country, and through various climes, finds the "DAILY BREAD" made up of different materials.

But the thinking man asks: Can this our earthly and changeable tabernacle be really built up in such manifold ways and from the most different materials; or, are there in all the varieties of food certain similar or identical constituents?

Science has answered this question satisfactorily; for chemical analysis has established the remarkable fact that all nutritious vegetables contain compounds corresponding, if not identical in composition with those nutriments derived from animals, with this difference that in the latter we find generally the blood-forming (plastic) elements prevailing, whilst respiratory matter predominates in the former.

Among the nitrogenous constituents of animal origin we reckon: fibrine, albumin and caseine, and we are likewise acquainted with a vegetable fibrine, albumen and caseine.

Thus if we boil the clarified juice of cauliflower, asparagus, turnips, etc., a coagulum is formed, which cannot be distinguished from the substance produced by boiling the serum of blood, or the white of an egg, previously diluted with water. This is *vegetable albumen.*

If wheat flour be placed upon a sieve and worked with the hand under a stream of water, a white sticky mass remains upon the sieve, which is *vegetable fibrine* (gluten.) The same substance is precipitated, if grape juice is alowed to stand for some time.

Another nitrogenized substance, the *vegetable caseine*, is chiefly found in the seeds of peas, beans, etc., which like the veg. albumin is soluble in water, but does not coagulate by heat. By boiling the solution the albumin separates on the surface in the form of a skin, and if we add a drop of acid a precipitate is formed similar to caseine

of animal milk. These three nitrogenized constituents occur in smaller or larger quantities in all vegetables, suitable as food for graminivorous animals.

These brilliant discoveries of modern chemistry render the process of nutrition in animals very simple, and account readily for the formation of their organs from such a great variety of aliments.

The food of carnivora is identical with their blood and muscle.[2.] Respiratory matter is obtained in the form of fat, always present, even in lean flesh.

The graminivorous animals receive in their food precisely the same compounds, on the presence of which the nutrition of carnivorous animals depends; for vegetable fibrine and animal fibrine, vegetable albumen and animal albumen scarcely differ even in form.[3.] We may say with Liebig, that the animal organism imparts to blood only its form, that it is incapable of creating blood out of other substances which do not already contain the chief constituents of that fluid. Either of these nitrogenous compounds may within the organism be converted into any of the others, (indeed blood fibrine has been changed into albumen by artificial means;) from the caseine in the mother's milk, the blood, muscles and albumen of the organs of the infant are formed; on the other hand, the mother who lives on bread and other vegetables produces from these not only the flesh and blood of her own body, but also the caseine in her milk.

Hence the doctrine of the vegetarians as to the supposed difference between vegetable and animal food is unfounded.

The inorganic constituents of our body, likewise essential for its preservation, must also be supplied in the food; for as mentioned before, our organism cannot create any

of them. A certain amount of iron is necessary for our blood, kitchen salt for digestion, phosphate of lime to build up our skeleton, etc.

In its importance upon the animal economy, phosphate of lime stands at the head of all other salts; we see rachitis when the system is unable to obtain the necessary quantity of bone-earth, or when (as during certain physiological processes, as pregnancy and dentition) a larger amount is consumed. We need only call to mind, that rachitis frequently if not always develops itself at the period of dentition, and that during pregnancy the consumption of phosphate of lime is so great, that but few traces of it can be found in the urine of pregnant females, and at this period fractures of the bones heal with difficulty, if at all. Indeed, Chassot, experimenting on birds, produced an artificial softening of their bones by feeding them with food containing little or no phosphate of lime. Even when children are fed on highly sanguigenous food, such as milk, meat or bread, there is apt to occur a deficiency of bone-forming matter, owing to a want of lime for converting all the phosphoric acid of these nutriments into the tri-basic phosphate ($3\ CaO, PO_5$) found in the bones. Lime is, consequently, in many cases, an excellent addition to food [4.] and is best given in the form of an aqueous solution.

Numerous experiments have shown, that aliments, in which either the plastic or respiratory matter is wanting, or which are destitute of certain saline constituents, cannot support life.[5.]

Dogs fed on sugar, starch or gum only, die of starvation almost as soon as others which were only supplied with water; even gluten, albumen etc., when given exclusively to the same animals, has not kept them alive beyond a few weeks.

Children are often injudiciously fed on diet composed chiefly of starch, tapioca, sago, arrowroot, etc., deficient of blood and bone-forming matter.

But few nutriments unite in themselves qualitatively and quantatively all the conditions, nor were they designed to make up for the expenditures of our system; hence the great importance of the principle in a dietetic and medical point of view, that our diet must be of a mixed and variable nature. By disregarding this law for any length of time the health of man will materially suffer.[6.] A natural instinct guides us in mixing and adjusting the several articles of food placed within our reach and is not confined to the individual, but is deep-rooted even in whole nations and tribes. The cravings of our appetite for a particular kind of food, or the disgust exhibited when the same dish is placed again and again before us, are thus explained.

The Irishman mixes cabbage with his potatoes; the Englishman bacon with beans, or milk and eggs with rice; the Italian eats his maccaroni, together with rich cheese; the German his humble rye bread with butter; the Swiss peasant his potatoes, with milk and cheese, &c.

When the proportion of respiratory matter is too small, it appears (as in meat diet) that the system appropriates sanguigenous matter to supply the animal heat, which is a very great waste, since meat affords the worst source of heat, as will be seen from the following table from Gregory's Handbook of Chemistry.

To obtain the same amount of heat we must employ,

Fat	100 parts;	(respiratory food.)
Starch	240 "	" "
Cane Sugar	249 "	" "
Grape Sugar	263 "	" "
Spirits, (at 50 per cent. Alcohol) .	266 "	" "
Fresh lean Meat	770 parts;	(plastic food.)

Civilization has adjusted the proportion more properly, by fattening cattle in the stall. Animals are thereby abundantly supplied with grain and so situated as to suffer from deficiency of oxygen. The conversion of starch, sugar, etc., into fat within the animal body (bees form wax, a real fat from honey) was for a long time doubted by some French savants, who pretended that the fat was not actually produced from starch, etc., but taken up already present in vegetable food, &c. Chemical analysis has fully cleared up those doubts, at the same time, however, established the fact, that some admixture of fat (if not already united with the food) must be made to starch, sugar, etc., in order to change them into fat; for hogs, ducks, etc., fed with such articles and destitute of any fat, could not be fattened. It appears that a little fat acts like a ferment on starch, etc., and causing this peculiar metamorphosis.

The following table taken from Liebig's Chemical Letters exhibits the relative proportions of plastic and respiratory matter in various kinds of food, all the respiratory ingredients, for the sake of comparison, being calculated as starch (10 parts of fat are calculated as an equivalent to 24 parts of starch:)

	PLASTIC.	RESPIRATORY, (AS STARCH.)	
Cows milk contains for	10	30	8.8 fat, and 10.4 milk sugar.
Human Milk	10	40	
Lentils	10	21	
Horse beans	10	22	
Peas	10	23	
Fat mutton	10	27	—11.25, fat.
Fat pork	10	30	—12.05, "
Beef	10	17	— 7.08, "
Hare	10	2	— 0.83.
Veal	10	1	— 0.41.
Wheat flour	10	46	
Oatmeal	10	50	
Rye flour	10	57	— 8.00
Indian corn	10	57	

	PLASTIC.	RESPIRATORY. (AS STARCH.)
Barley	10	57
Potatoes, (white)	10	86
Potatoes, (blue)	10	115
Rice	10	123
Buckwheat	10	130

Here we perceive that milk and grain, the two model nutriments, contain for 1 part of plastic, 3 to 5.7 respiratory matter.

When the food contains too little plastic food, enormous quantities have to be consumed to supply the waste of matter. Thus it will take 123 parts of rice to supply as much tissue as 33 parts of fat pork, or 125 parts of blue potatoes to yield as much tissue as 27 parts of beef.

The Chinese, who lives on rice, the negro who lives on the plantain, and the Irishman who lives on potatoes show by their corpulency and shape on what food they respectively live. Of course the greater part of surplus respiratory matter will not be assimilated and consequently wasted. Speaking of mankind at large, it is surprising to witness, how often the very man proceeding pretty correctly in compounding food for raising his stock, commits the greatest errors in the admixture of food designed for himself and family. Many a poor laborer, living almos exclusively on potatoes, rice, etc., would think it strange if he was told that his humble fare costs him from 3 to 5 times as much, as the better mixed and more appropriate meal of the more wealthy man.

Experience teaches, that a working man needs on an average, for his daily support, about 11 ounces of respiratory and 4½ ounces of plastic food; from whence it follows, that he requires per day according to Scheibler:[7.]

4 pounds rice.
15 " potatoes.
3¾ " bread.

$1\frac{1}{2}$ pounds bread, and 8 pounds of potatoes.			
$1\frac{1}{2}$	"	"	2 pounds potatoes and 11 ounces of meat.
$1\frac{1}{4}$	"	"	9 ounces peas and 4 ounces meat.
$1\frac{1}{2}$	"	"	and 18 ounces of beans.
$1\frac{1}{2}$	"	"	and 20 ounces peas, etc.

The amount of bodily or mental work any man performs, is measured by the daily waste of the tissues, muscular or nervous, etc., the place of which must be supplied by proper diet, if a maximum amount of work is to be performed, or health is to continue.

A different latitude will materially alter our wants. In a cold country health would suffer by feeding on fruit and similar vegetables, whilst the use of much bacon and other fat are unsuitable food for a southern clime; moreover, it is an easy matter to become a moderate eater at the South, but cold and hunger combined, the body cannot long endure.

Difference of climate, and with it change of diet and mode of living, will likewise modify the temperament, vary the beauty of feature and influence the national character of man; thus, hard labor, scanty and coarse food produce rude looks, whilst ease and good living is conducive of more elegant features, destroying almost difference of cast as exhibited in the United States.

It would also appear that those nations and tribes, living more on vegetable food, as the Hindoos, Chinese and inhabitants of the South Sea Islands, are a very meek and patient people, exhibited even in their peculiar mode of handicraft (such as shawl-weaving, inlaid work, etc.) But at the same time, it would seem as if such diet were not adapted to develop that energy and bold activity of mind observed in nations consuming mostly animal food.

Indeed man remains only an incomprehensible being as long as we consider and estimate him as isolated from nature, whilst as connected with the Cosmos, he may be

regarded as a product of nature, whose life and actions are a thousandfold interwoven in the life of nature of which he nevertheless remains lord and master.

But now comes the critical philosopher and informs us that man lives on nothing but air; for, says he, plants derive their food (with the exception of a little inorganic matter) from the air; animals obtain theirs directly or indirectly from vegetables—*ergo*, man lives on air.

This reasoning, we must acknowledge to be correct; but we who happen to live in a rather material age, will leave this airy dish to dyspeptic philosophers and happy lovers to feast upon.

NOTES.

Note 1, p. 4.

Taking as a comparison, the bodily weight of the new-born infant equal to 1., the following numbers express the relative weight of the body during its various stages of development: (C. Vogt's Physiologische Briefe.)

YEAR.	MAN.	WOMAN.	YEAR.	MAN.	WOMAN.
0	1.000	1.000	14	12.113	12.612
1	2.953	3.021	15	13.631	13.872
2	3.544	3.667	16	15.522	14.973
3	3.897	4.052	17	16.516	16.258
4	4.447	4.467	18	18.078	17.536
5	4.928	4.935	20	18.769	17.966
6	5.388	5.498	25	19.666	18.310
7	5.969	6.028	30	19.891	18.670
8	6.488	6.557	40	19.897	18.980
9	7.078	7.340	50	19.831	19.299
10	7.663	8.083	60	19.357	18.660
11	8.469	8.815	70	18.600	17.701
12	9.319	10.246	80	18.072	16.966
13	10.744	11.320	90	18.072	16.955

In old age man becomes also shorter and even the dimensions of his skull are lessened, and his mental faculties impaired.

Note 2, p. 7.

Gelatine containing nitrogen but differing in composition from the albuminous compounds is not capable of producing blood and if available at all by the system can only form membranes.

Note 3, p. 7.

This whole group of bodies are generally composed in 100 parts of 55. carbon; of 7.05 hydrogen; of 21.81 oxygen and of 15.96 nitrogen, toget' with small portions of sulphur and phosphorous.

No rational formulas of these compounds can be given, for we are entirely ignorant of their proximate componant parts and since the overthrow of Mulders Protein theory no other has been advanced in its stead.

Some chemists consider all these bodies as isomeric modifications, whilst others owing to their peculiar chemical and physical properties, believe them to be distinct and different compounds, like the members of the carbo-hydrogen series (starch, sugar, gum,) which, in spite of their equal percentage composition and although they may be partly converted into one another, are still described as distinct bodies.

Note 4, p. 8.

Liebig's improvement in the preparation of bread in Allgemeine Zeitung, 1854.

Note 5, p. 8.

A certain amount of water is also required, for animals perish likewise if their food is by artificial means deprived of water, and for the above mentioned reason the inorganic salts (lime, etc.,) with which this fluid is impregnated, cannot be considered mere impurities but are often promotive of our comfort and health.

Note 6, p. 9.

In our civilized state of existence it becomes moreover of great importance to render our food palatable and to impart to it such a form as to admit of more easy digestion ; this aim is accomplished in the art of cooking.

Note 7, p. 11.

The articles we use as food contain generally large quantities of water, thus in 100 pounds of the following nutriments we have :

Meat (mammalia)	77 pounds water.
" (fishes)	80 "
Wheaten bread (baked)	45—48 "
Cheese (Swiss)	28 "
Egg (without shell)	57 "
Beans	13 "
Peas	13—19 "
Wheat flour	14—16 "
Indian corn meal	14 "
Potatoes	75 "
Carrot	83 "
Turnip	90 "
Rice	14 "
Plantains	73 "
Apples	80 "
Onions	94 "
Water melon	94 "

It ought then not to surprise us much to see a man eat an entire fifty-pound water melon !